

**PATENT COOPERATION TREATY**  
**PCT**  
**INTERNATIONAL PRELIMINARY EXAMINATION REPORT**  
(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 110373	<b>FOR FURTHER ACTION</b>	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).
International Application No.  <b>PCT/AU2003/001623</b>	International Filing Date (day/month/year)  4 December 2003	Priority Date (day/month/year)  22 January 2003
International Patent Classification (IPC) or national classification and IPC  <b>Int. Cl. <sup>7</sup> F25J 1/00, 1/02, 3/02, 3/04, 3/08, 5/00; F25B 25/02, 27/02</b>		
Applicant  <b>LNG INTERNATIONAL PTY LTD et al</b>		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 3 sheets, including this cover sheet.
- ☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).
- These annexes consist of a total of sheet(s).
3. This report contains indications relating to the following items:
- I ☒ Basis of the report
  - II ☐ Priority
  - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
  - IV ☐ Lack of unity of invention
  - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
  - VI ☐ Certain documents cited
  - VII ☐ Certain defects in the international application
  - VIII ☐ Certain observations on the international application

Date of submission of the demand 1 April 2004	Date of completion of the report 26 April 2005
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer  <b>GREGORY DIVEN</b> Telephone No. (02) 6283 2992

**I. Basis of the report****1. With regard to the elements of the international application:\***

- ☐ the international application as originally filed.
- ☒ the description, pages 1-10, as originally filed,  
pages , filed with the demand,  
pages , received on with the letter of
- ☒ the claims, pages , as originally filed,  
pages , as amended (together with any statement) under Article 19,  
pages , filed with the demand,  
pages 11-14, received on 12 April 2005 with the letter of 12 April 2005
- ☒ the drawings, pages 1/5-5/5, as originally filed,  
pages , filed with the demand,  
pages , received on with the letter of
- ☐ the sequence listing part of the description:  
pages , as originally filed  
pages , filed with the demand  
pages , received on with the letter of

**2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.**

These elements were available or furnished to this Authority in the following language which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

**3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:**

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

**4. ☐ The amendments have resulted in the cancellation of:**

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/fig.

**5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).\*\***

\* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

\*\* Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement****1. Statement**

Novelty (N)	Claims 1-26	YES
	Claims	NO
Inventive step (IS)	Claims 1-26	YES
	Claims	NO
Industrial applicability (IA)	Claims 1-26	YES
	Claims	NO

**2. Citations and explanations (Rule 70.7)**

The following documents identified in the International Search Report have been considered for the purposes of this report:

WO 2001/088447  
 WO 2001/046634  
 WO 2002/086404  
 GB 2357140  
 US 6158241  
 US 4695303  
 WO 2002/079706  
 US 4065278  
 US 2003/0000698  
 EP 102087  
 GB 1596330  
 US 4702819

**Novelty (N)**

Claims 1-26 meet the criteria set forth in PCT Article 33(2) for novelty. The prior art published before the priority date does not disclose a process for the production of liquefied natural gas where the gas is pre-treated, then chilled partially using waste heat from the refrigeration cycle and then passing the chilled liquefied natural gas through a refrigeration cycle thus liquefying the gas stream.

**Inventive Step (IS)**

Claims 1-26 meet the criteria set out in PCT Article 33(3) with regard to the requirement of Inventive Step because the prior art does not obviously suggest to a person skilled in the art the chilling of the natural gas stream using waste heat from the refrigeration cycle prior to the gas stream being subjected to refrigeration.

**Industrial Applicability (IA)**

The invention defined in the claims is considered to meet the requirements of Industrial Applicability under Article 33(4) of the PCT because it can be made by, or used in, industry.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS

1. A process for the production of liquefied natural gas utilising a refrigeration cycle, the process comprising the steps of:
  - 5 (i) pre-treatment of a natural gas stream;
  - (ii) chilling of either or both of the resulting pre-treated natural gas stream or a refrigerant gas stream within the refrigeration cycle, the chilling being driven at least in part by waste heat from the refrigeration cycle; and,
  - 10 (iii) passing the pre-treated natural gas stream of steps (i) or (ii) through the refrigeration cycle and liquefying the pre-treated natural gas stream of steps (i) or (ii).
2. A process according to claim 1, wherein the waste heat comprises hot jacket water and/or hot exhaust gases from a main gas engine or turbine driven  
15 compressor.
3. A process according to claim 1, wherein the waste heat is provided from one or more of the group of prime movers, compressors, burning of flare or other waste gases or liquids, and solar power.  
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4. A process according to any one of the preceding claims, wherein the waste heat from the liquefaction step is utilised, at least in part, in the gas pre-treatment step.
- 25 5. A process according to any one of the preceding claims, wherein the chilling step condenses certain components of the pre-treated natural gas stream.
6. A process according to claim 5, wherein components of the natural gas stream condensed in this manner include one or more of water, heavy  
30 hydrocarbons and/or carbon dioxide.
7. A process according to any one of the preceding claims, wherein the

- 12 -

chilling step cools the gas stream to a temperature of between about -80°C and 10°C.

5 8. A process according to any one of the preceding claims, wherein the chilling of the pre-treated gas stream is conducted in a number of stages so as to allow the selective condensation and removal of various components thereof.

10 9. A process according to any one of the preceding claims, wherein the chilling of the refrigerant gas stream causes some components in the refrigerant gas to condense, the liquid thus formed being pumped and flashed to improve efficiency as in a conventional mixed refrigerant cycle.

15 10. A process according to any one of the preceding claims, wherein the chilling step utilises either a lithium bromide or an ammonia absorption chiller.

11. A process according to any one of the preceding claims, wherein either a turbo-expander or 'JT' valve or nozzle device is added between the chilling step and the liquefaction step to further cool the natural gas stream.

20 12. An apparatus for the production of liquefied natural gas, the apparatus comprising an absorption and/or membrane package for carbon dioxide removal, a dehydration package for water removal, a liquefaction package, at least one chiller and at least one refrigerant compressor package, the chiller being arranged so as to chill the natural gas stream to be liquefied.

25 13. An apparatus according to claim 12, wherein the liquefaction package further comprises the chiller arranged to chill a pre-treated natural gas stream from the solvent absorption and dehydration packages prior to passing that gas stream to a cryogenic heat exchanger.

30 14. An apparatus according to claim 12 or 13, wherein the chiller is located before, or as a part of, an amine and/or membrane package so as to assist in pre-

treatment of the natural gas stream.

15. An apparatus according to any one of claims 12 to 14, wherein the chiller comprises one or more chiller stages.

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16. An apparatus according to any one of claims 12 to 15, wherein the chiller is located in the refrigeration cycle to improve the efficiency thereof.

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17. An apparatus according to any one of claims 12 to 15, wherein the chiller is located in both the natural gas stream and refrigeration cycle, or in either one thereof.

18. An apparatus according to any one of claims 12 to 17, wherein the chiller is driven by waste heat from the or each refrigerant compressor packages.

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19. An apparatus according to claim 18, wherein waste heat is also directed to an amine package for amine regeneration and/or to the dehydration package for regeneration of molecular sieves used therein.

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20. An apparatus according to any one of claims 12 to 19, wherein the chiller is provided in the form of either an ammonia or lithium bromide absorption chiller.

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21. An apparatus according to claim 20, wherein the ammonia absorption chiller cools the gas stream to about -30 to -80°C whereas the lithium bromide absorption chiller cools the gas stream to about 0 to 10°C.

22. An apparatus according to any one of claims 12 to 21, wherein a turbo-expander or 'JT' valve or nozzle device is added downstream of the chiller.

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23. A refrigeration process wherein either or both of a process gas stream or a refrigerant gas stream within a refrigeration cycle are chilled in a chilling step, wherein waste heat from the refrigeration cycle is utilised in the chilling step,

thereby reducing a refrigeration load.

24. A refrigeration process according to claim 23, wherein the refrigeration process is utilised in either of an air separation plant or an LPG extraction process.

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25. A refrigeration process according to claim 23 or 24, wherein the chilling step is employed to pre-treat the process gas stream.